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Determination of the Chemical Properties of Some Selected Vegetable Oils Sold in Gombe Main Market, Gombe State, Nigeria

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Abstract

Vegetable oils are widely utilized as essential lipid sources in food production, necessitating routine evaluation of their nutritional and chemical quality. This study assessed the quality of four commonly consumed edible vegetable oil brands in Gombe, Gombe State: Palm oil (Al-Hilal), Turkey oil, Power oil, and Kings oil. Samples were collected from the Gombe main market and analyzed for saponification value, iodine value, and peroxide value. These parameters were compared against the standards set by the Standard Organization of Nigeria (SON). Turkey oil exhibited the lowest saponification value (192.43 ± 0.51 mg KOH/g), though all oils fell within the SON-recommended range of 185–205 mg KOH/g. The iodine values indicated low levels of unsaturated fatty acids across all samples, with palm oil showing the highest (15.29 ± 0.49 g) and Turkey oil the lowest (6.61 ± 0.63 g). Peroxide values for all samples were well below the 10 meq/kg threshold for rancidity, indicating freshness and stability. Overall, the results demonstrate that all vegetable oil samples met the quality standards set by SON and the Nigerian Industrial Standard (NIS). It

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is therefore concluded that the oils are unadulterated, of high quality, and safe for public consumption, reflecting proper processing and storage practices.

Keywords: Vegetable Oil; Saponification Value; Iodine Value; Peroxide Value; Standard Organization of Nigeria (SON)

INTRODUCTION

Vegetable oil is an important and widely used lipid source for our everyday food products. Its application is increasing day by day for food purposes and for manufacturing other products. However, the quality of some vegetable oils are compromised and not up to standards to meet consumer satisfaction in terms of physico-chemical properties and texture or the stability of the food products [1,2].

Physical properties of fat and oils such as viscosity, melting point, temperature and texture are highly related to their chemical properties; as such determination of some of the chemical properties of the oil will give more insight into the nature of their physical properties. For instance, the viscosity of oil is related to chemical properties of the oil such as saponification values, a measure of chain length and saturation/unsaturation. It has been reported that viscosity decreases with an increase in unsaturation and increases with high saturation and polymerization, so it relates to the melting point of the oil as well [3,4].

More also the melting point of oil is related to its chemical property known as peroxide values, and are indicative of their tendency to become rancid due to the presence of unsaturation in them. Furthermore, the rancidity of oils depends on the period, temperature and process of storage [5].

There is no doubt that a lot has been put into the study of the properties of vegetable oils. Many different methods have been developed overtime but most of them have one problem or the other. Vegetable oils are widely employed in the food industry, but they get easily oxidized during processing, circulation, and preservation. The oxidation of fats and oils in food can result in food toxicity. From the perspectives of food quality and safety, the determination of the chemical parameters of oils such as peroxide value (PV), saponification value and iodine value, is one of the most important quality control measurements for edible oils [6,7].

The stability of vegetable oil can be negatively affected by changes in its physicochemical properties over time, including factors such as exposure to light, heat, and air, as well as the presence of impurities or contaminants. According to a study by Liu *et al.*[8] "the physicochemical properties of vegetable oils are important indicators of their quality and stability, and can be affected by various factors such as processing methods, storage conditions, and the presence of impurities".

Nigeria is one of the countries of the world with a variety of oil seeds notably groundnut oil, palm oil, soya beans and cotton seeds. The economic importance of oil crops has made it necessary that they be properly investigated, to ascertain their quality, since this is an important criterion for marketing and processing seed oil [9].

Therefore, this study is aimed to assess the nutritional qualities of some edible vegetable oils commonly sold in Gombe main market by determining their chemical properties.

MATERIALS AND METHODS

Materials

Sample Collection

Four varieties of edible vegetable oils namely, Palm oil, Turkey oil, Power oil and Kings oil used in this study were obtained from Gombe main Market, Gombe State, Nigeria.

Chemicals and Reagents

Potassium iodide, acetic acid, chloroform, sodium thiosulphate, starch, ethanol 95%, diethylether, bromine, hydrochloric acid, sodium hydroxide and phenolphthalein indicator.

Methods

Peroxide Value (PV)

The peroxide value of the oil samples was determined using the methods of Low and Ng,[10].

Principle

Peroxides are estimated through their ability to liberate I_2 from KI in glacial acetic acid solution. The PV of fats is a measure of its contents of reactive oxygen in terms of mM of peroxides or milli equivalent of oxygen per 100 grams of fat.

Procedure

The oil sample of 2 g was weighed into a 25-ml test tube. Potassium iodide 2g and 20 ml of the solvent mixture (CH_3 COOH: $CHCl_3$ i.e. 2: 1) was added in loosely stopper test tube. The content of the tube was boiled within 30 seconds by placing the test tube in a boiling water bath. This was boiled for another 30 seconds. The Test tube was cooled immediately under tap water and the contents of the tube transfered into a conical flask. Potassium iodide of 5% of 20 ml and 50 ml of distilled water were added to the flask and titrated against 0.002 N sodium thiosulphate using starch indicator towards the end (Meyer, 2000). The peroxide value is calculated using the formular:

$$\text{Peroxide value} = \frac{V}{W}(\text{ml of 0.002 N. Sodium thiosulphate per g})$$

Where,

v. = ml of 0.002N. $Na_2S_2O_3$ used

w. = weight of the sample taken in g

Iodine Value

The iodine value was determined using the Wijs method as described by AOCS [11].

Principle

Iodine value test is used to determine the amount of unsaturation in the form of double bonds which reacts with iodine compounds. The higher the iodine value the more unsaturated fatty acid bonds present in the oils.

Procedure

The quantity of the oil weighing 0.6 g was melted in a clean dry 250-ml glass-stoppered conical flask. Carbon tetrachloride of 10 ml and 25 ml of Wijs solution were added, the stopper was replaced after moistening with potassium iodide solution. The solution was mixed, and stored in a dark cupboard for 30 minutes. Potassium iodide of 10% of 15 ml solution and 100 ml of distilled water were added. This was titrated with 0.1N $Na_2S_2O_3$ solution using starch as an indicator near the end point. Blank determination was done alongside without the fat.

$$Iodine\ Value = \frac{(Blank\ titre - Sample\ titre) \times N\ of\ Na_2S_2O_3}{Wt\ of\ sample\ (g)} \times 12.69$$

Determination of Saponification Value

The saponification value of the oil samples was determined using the methods of Low and Ng, [10].

Principle

Saponification value refers to the number of milligrams of KOH required to completely hydrolyze (saponify) one gram of oil/fat. A known amount of the oil or fat is refluxed with excess amount of standard alcoholic potash solution and the unused alkali is titrated against a standard acid.

Procedure

Two grams of the oil sample was weighed into a clean dried conical flask and 25ml of alcoholic potassium hydroxide was added. The flask was heated for an hour with frequent shaking. Phenolphthalein indicator of 1% of 1 ml was added and the hot excess alkali was titrated with 0.5 mol/dm^3 hydrochloric acid (HCl) until it reached the end point where it turns colorless. A blank titration was carried out at the same time and under the same condition.

The saponification value was calculated using equation below:

Saponification Value = $\frac{(S-B) \times M \times 56.1}{W}$

B and S are titre values of blank and sample respectively, M is the Molarity of HCl and 56.1 is the molecular weight of KOH.

RESULTS

The results obtained for the chemical parameters of the four different oil samples obtained from Gombe main Market is shown in table 1. The results showed that Turkey oil had the least saponification value (192.43±0.51mg KOH/g oil) than the remaining samples (Power oil 199.43±0.51 mg KOH/g oil, Kings oil 198.53±0.50 mg KOH/g oil, and Palm oil 198.30±1.13 mg KOH/g oil) but they all fall within the recommended range for saponification value (185-205 mg KOH/g). The iodine values of all the oils obtained were

found to be very low which showed that they contain less unsaturated fatty acids with palm oil having the highest content of unsaturated fatty acid with an iodine value of 15.29±0.49g , while Turkey oil was found to contain the least unsaturated fatty acid with an iodine value of 6.61±0.63g . The results for peroxide value (PV) obtained for the oils in this study were all far less than 10 meq/kg recommended for rancidity to occur as indicated in table 1.

Table 1: Chemical parameters of four brands of vegetable oils determined at room temperature

Groups	Saponification value (mg KOH/g oil)	Iodine value (g)	Peroxide value (milli equivalents)
Power Oil	199.43±0.51	9.89±0.12	0.99±0.03
Turkey Oil	192.43±0.51	6.61±0.63	0.74±0.03
Kings Oil	198.53±0.50	13.11±0.18	0.90±0.03
Palm Oil	198.30±1.13	15.29±0.49	3.18±0.16

Values are expressed as Mean ± S.D of triplicate measurement. N=3

DISCUSSION

From the results obtained (Table 1), all the oil samples have saponification value below 200 mg KOH/g oil with power oil, kings and palm oil having saponification values within the same range. Turkey oil (192.43±0.51) had a lower saponification value compare to the rest. According to the work reported by Abdulkadir and Jimoh, [12] the standard range of saponification value falls within (185-205). Therefore, all the oils fall within the recommended range/ values. The Saponification value (SV) is used to determine the saponification number of a fat or oil, which is an index of the average molecular weight of the triacylglyceride in the sample. The smaller the SV the higher or longer the average fatty acid chain length. Adulteration of fat or oil with unsaponifiable matter can lead to drop in saponification value [4]. Therefore, Turkey oil could be said to contain longer chain fatty acids than the others.

The oil samples contained varied range of iodine value in ascending order as thus: Turkey oil (6.61±0.63), Power oil (9.89±0.12), Kings oil (13.11±0.18) and Palm oil (15.29±0.49) (Table 1).

The Iodine value (IV) is a measure of degree of unsaturation (C=C) in relation to the amount of fat or oil. Iodine value is defined as the gram of iodine absorbed per 100g sample. Hence, the higher the iodine value the greater the degree of unsaturation. The IV is used to characterize fat and oil, to follow the hydrogenation process in refining, and as an indication of lipid oxidation, since, there is a decline in unsaturation during oxidation [13]. The iodine value of all the oils obtained (Table 1) are very low which showed that they contain less unsaturated fatty acid with palm oil having greater proportion of unsaturated fatty acid having a value of 15.29±0.49, while Turkey oil was found to contain the least unsaturated fatty acid having iodine value of just 6.61±0.63. Measurement of IV is important as it gives the extent to which the lipid sample can be prone to oxidation and thus become rancid [14].

The peroxide values (PV) obtained for the four oil samples (Table 1) were all less than 10 meq/kg. Palm oil had the highest value of 3.18±0.16 while Turkey oil had the least value of 0.74±0.03 and this indicates that they are all safe from being rancid based on the values required for rancidity to occur as reported by Adelakun *et al.* [15]. Peroxide value is also used to check the presence of unsaturation just like the Iodine value (IV) [16]. Lipolysis is the hydrolysis of glyceride molecule into its constituent fatty acids, and this process is enhanced rancidity, which refers to as the offensive odors and flavors resulting from lipolysis (hydrolytic rancidity) or lipid oxidation (oxidative rancidity). Because of their volatility, production of short-chained fatty acids can result in off- odors. It is also attributed to presence of or level of unsaturation in the lipid sample. Rancidity test is used to detect the extent of spoilage in fat and oil.

CONCLUSION

Vegetable oil serves as important component of diets, serving as a good source of lipid and fatty acids for human nutrition including the repair of worn out tissues, new cells formation as well as a useful source of energy. The nutritional quality of Power oil, Kings oil, Turkey oil and Palm oil have been investigated using chemical parameters like IV, PV and SV in order to ascertain their importance, safety for human consumption, and other related uses. The results obtained from the study showed that the chemical parameters of the vegetable oil samples investigated in this study are within the recommended range set by Standard Organization of Nigeria (SON) and Nigerian Industrial Standard (NIS). Therefore, it is

concluded that the vegetable oil samples studied were not adulterated and that the processing and storage methods employed were standard.

Recommendtions

It is recommended that vegetable oils sold in our markets and other provision stores be assessed regularly by Standard Organization of Nigeria (SON) or any relevant agencies in order to avoid consumption of partially or completely rancid oils that could cause potential food poisoning.

REFERENCES

1. Reyes-Hernández, J., García-Salas, P., Romero, I., & Revilla, I. (2007). Characterization of commercial edible oils in the Spanish market including trans fatty acids. *Journal of Food Composition and Analysis, 20*(2), 127–132.
2. Nduka, J. K., Omozuwa, P. O., & Imanah, O. E. (2021). Effect of heating time on the physicochemical properties of selected vegetable oils. *Arabian Journal of Chemistry, 14*(4), 103063. https://doi.org/10.1016/j.arabjc.2020.103063
3. Kim, Y. J., Choi, I. S., & Choi, Y. E. (2010). Physicochemical properties and quality characteristics of blended sesame oil with other vegetable oils. *Korean Journal of Food Science and Technology, 42*(6), 709–714.
4. Ichu, C. B., & Nwakanma, H. O. (2019). Comparative study of the physicochemical characterization and quality of edible vegetable oils. *International Journal of Research in Information Science, Applied and Technology (IJRISAT), 3*(2), 1–9.
5. Gotoh, N., Wada, S., & Matsuda, T. (2011). Essential oils as natural food preservatives: Potential and limitations. In *Bioactive foods in promoting health* (pp. 333–354). Academic Press.
6. Neagu, A. A., Niţa, I., Botez, E., & Geaca, S. (2013). A physico-chemical study for some edible oils properties. *Ovidius University Annals of Chemistry, 24*(2), 121–126.
7. Akinoso, R., Raji, A. O., & Adeyemi, I. A. (2010). Peroxide value as an index of storage stability of fried and baked snack foods. *African Journal of Food Science, 4*(4), 127–133.
8. Liu, X., Huang, Q., Zhang, W., & Wang, J. (2020). A review of the physicochemical properties of vegetable oils and their impacts on quality and stability. *Advances in Food and Nutrition Research, 93*, 45–84. https://doi.org/10.1016/bs.afnr.2019.12.002
9. Abayeh, O. J., Ajibola, O. O., & Olayiwola, I. O. (1998). Seed oil quality parameters of some cultivated legumes in Nigeria. *Plant Foods for Human Nutrition, 52*(4), 315–322.
10. Low, L. K., & Ng, C. L. (1987). *Laboratory manual on analytical methods and procedures for fish and fish products*. Southeast Asian Fisheries Development Center, Marine Fisheries Research Department. http://hdl.handle.net/1834/41021
11. American Oil Chemists' Society (AOCS). (1974). *Official method Cd 1-25*. Champaign, IL: AOCS Press.
12. Abdulkadir, A. F., & Wlo, J. (2013). Comparative analysis of physico-chemical properties of extracted and collected palm oil and tallow. *ChemSearch Journal, 4*, 44–54.

13. Bukola, C., Gabriel, A., Patience, A., & Omoniyi, A. (2015). Effects of different storage temperature on the physicochemical properties of cooking oils available in Nigeria markets. *European Journal of Academic Essays, 2*(10), 7–14.
14. Adebowale, Y. A., Adeyemo, S. M., Adegunwa, M. O., & Adebowale, O. F. (2021). A comparative study of trans fatty acids in partially hydrogenated soybean oil and palm olein. *Journal of Food Quality*, Article ID 6622260. https://doi.org/10.1155/2021/6622260
15. Adelagun, R. O., Berezi, E. P., Fagbemi, J. O., Igbaro, O. J., Aihkoje, F. E., Ngana, O., & Garba, M. S. (2023). Evaluation of level of rancidity of edible oil in some fried snacks food. *Journal of Chemical Society of Nigeria, 48*(1).
16. Akinoso, R., Aboaba, S. A., & Olayanju, T. M. A. (2010). Effects of moisture content and heat treatment on peroxide value and oxidative stability of un-refined sesame oil. *African Journal of Food, Agriculture, Nutrition and Development, 10*, 4268–4285. https://api.semanticscholar.org/CorpusID:96677689